PRIVATE
DEPOSITORY

ROYAL ASTRONOMICAL SOCIETY.

VOL. V. *April* 8, 1842. No. 22.

THE PRESIDENT, LORD WROTTESLEY, in the Chair.

John Jenkins, Esq. of Wind Street, Swansea; and James Sweetman Eiffe, Esq. of South Crescent, Bedford Square, London, were balloted for, and duly elected Fellows of the Society.

The following communications were read:—

I. On the Aggregate Mass of the Binary Star 61 *Cygni*. By S. M. Drach, Esq.

The truth of universal gravitation having been confirmed by the elliptic form of the orbits of binary stars, it follows that knowing the absolute distances of the component members and their period of revolution round each other, we are able to deduce their aggregate mass compared with that of our sun and a planet, by exactly the same process which acquaints us with the various masses of the planets which are attended with satellites.

The ratio of the sums of the masses of the component bodies in two such systems being then that of the cubes of the mean distances of the components, multiplied into that of the inverse squares of their periods of revolution round each other, we may assume that one system is composed of the earth and sun, and we have then two cases to consider; 1st, when this binary star is of very small mass compared with the sun, in which case the system would revolve about the sun, the centre of gravity being near the sun's centre; and, 2dly, when the star's mass is much superior to that of the sun, in which case the orbital motion of the star would be only apparent, and owing to the real revolution of the solar system round it.

Applying these remarks to the case of the star 61 *Cygni*, and assuming Bessel's value of the parallax, and the usually assumed elements of the orbit of this binary system, it appears evident that this system is unconnected with the solar system. It does not, however, appear impossible that both systems revolve round a third at an immensely greater distance than that of the sun from the earth.

The author, in conclusion, adverts to the great importance, in the present advanced state of practical Astronomy, of noting the positions of the stars having the greatest proper motions with all possible accuracy, and of rigorously comparing the deduced proper motions at equal intervals of time, for the purpose of discovering whether the motions are performed in one plane, and whether they are uniform; and also to the importance of having a catalogue of stars accurately arranged in order of brilliancy by means of photometrical observations, as an essentially requisite element in the determination of their relative distances from the earth.

II. Second Note on the Mass of *Venus*. By R. W. Rothman, Esq.

In a Note on the Masses of *Mercury* and *Venus*, read at the Meeting of this Society on the 14th of January, I stated that a consideration of the motion of the perihelion of *Venus* had led me to conclude, that it was necessary to diminish the mass of *Mercury* by a quantity estimated approximately at $\frac{4}{10}$. This would make the mass in question $\frac{1}{3182843}$. I may observe in passing, that in the notice of the meeting of the 14th of January, page 132, there is a misprint in the algebraical formula for the motion of the perihelion; but this is merely a typographical error, and the calculations are correct. At the same meeting there was read an extract of a letter from Professor Encke to the Astronomer Royal, from which it appears that Professor Encke, guided by very different considerations has been led to fix the mass of *Mercury* in the first instance at $\frac{1}{3091947}$, and subsequently at $\frac{1}{4865751}$.

At the end of my Note, I stated that the secular equations affecting the orbit of *Mercury* appeared to confirm the necessity of an augmentation of the mass of *Venus*, to which I had been led by an examination of the secular motion of the node of the latter planet. But, in fact, this deserves somewhat further developement.

I have calculated the secular equation of the node of *Mercury* with the same planetary masses as those assumed in my first node, excepting that of *Mercury*, which I have supposed equal to $\frac{1}{3182843}$.

I have used the following values of the greater axes which are slightly different from those employed before:—

$$\begin{aligned} ☿ &= 0{\cdot}38709888 \\ ♀ &= 0{\cdot}72333228 \\ ♁ &= 1{\cdot} \\ ♂ &= 1{\cdot}52369210 \\ ⚳ &= 5{\cdot}20115524 \\ ♄ &= 9{\cdot}53797320 \\ ♅ &= 19{\cdot}18251740 \end{aligned}$$

With these data I obtain for the annual sidereal motion of the node of *Mercury* :—

$$\frac{d\Omega_0}{dt} = -7''\cdot264 \quad -0''\cdot0621\,\mu_0 - 3''\cdot8665\,\mu_1 - 0''\cdot8915\,\mu_2 - 0\cdot0991\,\mu_3 - 2\cdot2292\,\mu_4 - 0\cdot1129\,\mu_5 - 0\cdot0022\,\mu_6$$

If we assume Encke's second value of the mass of *Mercury*, namely $\frac{1}{4865751}$, and suppose $\mu_2, \mu_3, \mu_4, \mu_5, \mu_6$ each $= 0$

then $\frac{d\Omega_0}{dt} = -7''\cdot242 - 3''\cdot867\,\mu_1$.

Now, according to Lindenau, the tropical motion of the node from 1631 to 1802 is 42″·534 annually; hence, with a precession of 50″·21, the annual sidereal motion is 7″·676

$$\therefore -0''\cdot434 = -3''\cdot867\,\mu_1$$
$$\mu_1 = +0\cdot11$$

With the same data as before I have calculated the motion of the perihelion of *Mercury*, for which I find the following expression,

$$\frac{d\pi_0}{dt} = +5''\cdot44335 \quad +2''\cdot88796\,\mu_1 + 0''\cdot86028\,\mu_2 + 0\cdot02881\,\mu_3 + 1\cdot59026\,\mu_4 + 0\cdot07604\,\mu_5$$

The mass of *Mercury* does not enter into this expression. The coefficient of μ_6 is insensible. Supposing now $\mu_2, \mu_3, \mu_4, \mu_5$ each $= 0$,

$$\frac{d\pi_0}{dt} = +5''\cdot44335 + 2''\cdot8876\,\mu_1.$$

Now Lindenau gives for the tropical motion of the perihelion 56″·354; or, with a precession of 50″·21, an annual sidereal motion $= +6''\cdot144$.

$$\therefore 6''\cdot144 = 5''\cdot443 + 2''\cdot888\,\mu_1$$
$$\therefore \mu_1 = \frac{0\cdot701}{2\cdot888} = 0\cdot25.$$

The node of *Venus*, as given in my first note, furnishes us, assuming Encke's second mass of *Mercury*, and neglecting the terms which contain $\mu_2, \mu_3, \mu_4, \mu_5, \mu_6$, with the equation

$$-1''\cdot60 = -5''\cdot174\,\mu_1$$
$$\therefore \mu_1 = +0\cdot31.$$

The three values of μ_1 are then

$$\mu_1 = +0''\cdot11$$
$$\mu_1 = +0\cdot25$$
$$\mu_1 = +0\cdot31$$

or, taking the mean $\mu_1 = 0''\cdot22$.

This, of course, is only given as an approximate estimation; but it seems difficult to resist the conclusion that the mass of *Venus* should be augmented by a quantity which cannot be put lower than one-tenth, and is probably considerably larger. An augmentation of one-tenth would make this mass $\frac{1}{365308}$, of two-tenths, $\frac{1}{334866}$.

III. On a Method of Determining the Latitude at Sea. By M. C. L. von Littrow, Adjoint-Astronomer at the Imperial Observatory at Vienna. Communicated by the Rev. W. Whewell, Master of Trinity College, Cambridge.

IV. On the Rectification of Equatoreals by Observations of Stars on the Meridian and at an Hour-Angle of Six Hours. By M. C. L. von Littrow. Communicated by the Rev. W. Whewell.

V. The Parallax of α *Centauri* deduced from Mr. Maclear's Observations at the Cape of Good Hope in the years 1839 and 1840. By Professor Henderson.

An abstract of the principal contents of this paper will be found in Professor Henderson's letter, contained in the last *Monthly Notice*, viz. that for March 1842. In addition, the author gives the following facts relating to the history of the observations of the star α *Centauri*. The earliest recorded observations which he has found are those of Richer, at Cayenne, in 1673, and of Halley, at St. Helena, in 1677; but neither of these astronomers mentions it as being double. Feuillée appears to have been the first person who observed it to be double, his observations being made at Conception, in Chili, in July 1709, with a telescope of 18-feet focal length. He estimates their magnitudes as being of the third and fourth, the smaller star being the more westerly, and their distance as equal to the apparent diameter of the smaller star (*Journal des Observations Physiques*, &c., par Louis Feuillée, tome i. p. 425; Paris, 1714).

La Condamine observed the star during the expedition to Peru for measuring an arc of the meridian (see *Philosophical Transactions for* 1749, p. 142). He estimated it as being of the first magnitude, and recognised its duplicity; and he remarked that the larger star was northward of the other, and to the east of it. From La Caille's observations in 1751–2, the distance of the two stars appears to have been 22″·5. Maskelyne observed them at St. Helena in 1761 (see *Philosophical Transactions for* 1764, p. 383), and estimated them as being of the second and fourth magnitudes. Their distance, as observed with a divided object-glass micrometer, he found to be from 15″ to 16″. From this time to the time of the institution of the Paramatta Observatory, the author has met with no observations of the distance of the stars. Mr. Dunlop, in the years 1825–6, found the distance to be 23″

(see *Memoirs of the Royal Astronomical Society*, vol. iii. p. 265), since which time it has been decreasing at the rate of more than half a second *per annum*. The angle of position scarcely appears to have changed since the time of La Caille; whence it may be inferred that the relative orbit is seen projected into a straight line, or a very eccentric ellipse; that an apparent maximum of distance was attained in the end of the last or the beginning of the present century; and that, about twenty years hence, the stars will probably be seen very near each other, or in apparent contact; but the data are at present insufficient to give even an approximation to the major axis of the orbit and time of revolution.

VI. Observations of the beginning and end of the Solar Eclipse of July 18, 1841. By Dr. Cruikshank. Communicated by G. Innes, Esq.

The eclipse was observed at Fyvie Castle, in latitude 57° 26′ 40″·7 north, and longitude $9^m\ 32^s{\cdot}6$ west, where there is a good clock by Hardy and a fine transit instrument. The magnifying power of the telescope used was about thirty.

	h	m	s		s
Time of the beginning of the eclipse...	2	15	4	; uncertain to	10
Time of the end.....	2	57	30	———	2.

The President announced that, at the next ordinary Meeting, it was the intention of the Astronomer Royal to give an account, illustrated by a model, of a zenith sector of peculiar construction, to be used in the Ordnance Survey.

London: Moyes and Barclay, Castle Street, Leicester Square.